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One specimen from Calmali, original No. 65, shows such an abundant horn development that it ranks fifth largest as to length of horn in Rowland Ward's list (sixth edition). The horns, sixteen and one eighth inches long, show a remarkably divergent tendency, there being seventeen and one half inches between them at the fork. The base measurement is six and one quarter inches, and the general form is clean and symmetrical, not stumpy, knobbed and aberrant-looking like some of the others from the same locality. There seems to be, however, in all the California horns a tendency to a very sharp angular bend at the terminal portion, instead of a gentle or even curve. Therefore this new race of Pronghorn has a characteristic skull modification and can at times produce fine typical horns, in spite of its seemingly unfavorable environment.

The type locality of *A. americana* is an indefinite one and is referred to the Plains of the Missouri. The five *americana* skulls used for comparison were taken near Percy, Wyoming, and are Nos. 43, 46, 49, 50, 52 in the Museum of Comparative Zoology.

J. C. PHILLIPS

WENHAM, MASS.

THE AMERICAN PHILOSOPHICAL SOCIETY

THE annual general meeting of the American Philosophical Society was held in the rooms of the society in Philadelphia, April 17 to 19, inclusive, and constituted a most notable series of sessions. There were a large number of papers presented, their general character being of a high order of merit and the scope of subjects included wide.

The meeting was opened on Thursday afternoon, President W. W. Keen, LL.D., in the chair, when the following papers were read:

The Biographies of Suetonius: JOHN C. ROLFE, Ph.D.

The Etymology of the Word "Ill": HERMANN COLLITZ, Ph.D.

While most etymologists agree in regarding the word "ill" as a loan word from Scandinavian, no plausible etymology has as yet been given of the old Norse word ("illr") from which it is derived. The traditional etymology of the latter word, identifying it with English "evil," is untenable, for

phonetic reasons. Both the form and the meaning of this word, however, may be accounted for by regarding it as the Scandinavian equivalent of the English word "idle."

The Treaty Obligations of the United States relating to the Panama Canal: CHARLEMAGNE TOWER, A.B., LL.D.

Former Ambassador Tower discussed the basis upon which the Hay-Pauncefote treaty was concluded with Great Britain, and pointed out the legal obligation of the United States arising therefrom. He went back to the earliest discoverers and navigators and brought up to the present time the history of the governments of Central America, to show our connection with the enterprise of constructing the canal.

He quoted the Clayton-Bulwer treaty, signed in Washington in 1850, by which the governments of the United States and Great Britain declared that neither would ever obtain or maintain any exclusive control over the ship canal, would fortify or colonize, or exercise any dominion over Nicaragua, Costa Rica, the "Mosquito Coast" or any part of Central America.

Also, that neither Great Britain nor the United States would take advantage of any intimacy or alliance that it might have with any government through whose territory the canal should pass, to acquire or hold any rights or advantages in regard to commerce or navigation which should not be offered on the same terms to the citizens or subjects of the other.

By the Hay-Pauncefote treaty of 1901, Mr. Tower said that, being desirous to facilitate the construction of a ship canal to connect the Atlantic and Pacific Oceans, by whatever route might be considered expedient, and to remove any objection which might arise out of the Clayton-Bulwer treaty to the construction of such canal under the direction of the United States, without impairing the general principle of neutralization, the two nations agreed that the Hay-Pauncefote treaty should supersede the former treaty.

It was agreed also that the canal should be built by the United States, which should enjoy the exclusive right to provide for the regulation and management of it. To make the understanding between the two nations plain, the following specific stipulation was entered into:

"The United States adopts as the basis of the neutralization of such ship canal, the rules substantially as embodied in the Convention of Constantinople, for the free navigation of the Suez Canal, and further, 'The Canal shall be free and

open to the vessels of commerce and of war of all nations observing these rules, on terms of entire equality, so that there shall be no discrimination against any such nation or its citizens or its subjects, in respect to the condition or charges for traffic or otherwise.' "

In view of all this the speaker urged that the United States is in honor bound never to do or allow anything which can be interpreted as in any way inconsistent with the terms of our treaties.

A Counsel of Perfection. A Plan for a State University and for an Automatic Collection and Distribution of a State Tax for Higher Education: JOSEPH G. ROSENGARTEN, A.M., LL.D.

In view of the proposed convention to revise the constitution of Pennsylvania, it may not be inappropriate to urge the preparation, consideration and discussion of a provision in the constitution for a mill tax for higher education in Pennsylvania.

The founder of the Philosophical Society was also the founder of what is now the University of Pennsylvania.

From the suggestion of a building big enough for George Whitfield's great audiences, Franklin drew the inspiration in 1740 for the Academy of Philadelphia, which grew into the College of Philadelphia, the University of the State of Pennsylvania, and the University of Pennsylvania of our own day.

Franklin (to-day Franklin and Marshall) College, of Lancaster, Pa., was a tribute paid to him in the closing years of his long useful life by his admiring contemporaries.

The constitution of Pennsylvania, adopted in his lifetime, pledged the support of the state to the university.

To-day there are, as reported by the National Bureau of Education, 87 state universities, and other state-aided institutions of higher education. More than twenty-five of them receive the proceeds of the so-called mill tax rate, varying in amount and methods of collection and distribution. Notable among them is the University of Wisconsin, with a tax of three eighths of a mill, yielding \$1,103,029, with a total income from the state of \$1,552,398, and from the United States of \$80,000, under the Morrill land grants, and returning to the state a large and varied service in public work and commissions of many useful kinds.

Under the same fostering care, other state universities have grown rapidly into importance—notably Michigan, Indiana, Colorado, Illinois, Iowa, Kansas, Nebraska, Texas, and state aid thus

secured by the mill tax has been supplemented by many magnificent gifts from individuals.

The question of how best to make constitutional provision for higher education has been discussed, and its advantages affirmed by Andrew White, of Cornell; President Swain, of Swarthmore; President Beardshear, of Iowa; President Jesse, of Missouri; Professor Herbert B. Adams and Professor Maphis, of the University of Virginia; Professor Lefevre, of the University of Texas; President Ellis, of Ohio, and by the representative educational leaders from all parts of the country.

In Pennsylvania, with a state revenue of over thirty millions, a mill tax would produce an income large enough to support all the universities and colleges and institutions of higher education in a way to make them of infinite benefit and credit to the state.

With a provision in the constitution for such a mill tax for higher education should go power in the legislature to create a state board of education, including in it the governor and principal officers of the state *ex officio* and representatives of universities and colleges and technical schools and museums.

Let the state be divided into three sections, eastern, middle and western, each with its local educational council, consisting of representatives from all the institutions of higher education in the section, these in turn to send one or more representatives to the state board of education. That body could frame a plan on which the proceeds of the mill tax should be distributed, according to numbers, standards, efficiency and other conditions prescribed for a share of the income from the mill tax.

In due time the weak colleges would see the advantages of union with others, thus increasing efficiency.

The University of Pennsylvania would naturally be the head of higher education in and for the state, other universities and colleges being affiliated with it.

State College should be made the great agricultural school for the state, attracting to it all branches affiliated in that important work, veterinary schools, forestry, conservation of natural resources, etc.

The University of Pittsburgh would be the head of higher education in the western part of the state, and naturally would become the center of all work for educating men in mining, metallurgy, electricity and the other arts and sciences needed in developing the great resources of the state.

Technical schools, the Franklin Institute, the Drexel Institute and similar bodies, as well as such institutions as the Academy of Natural Sciences, the Academy of Fine Arts, the Carnegie Institute of Pittsburgh, should be affiliated.

All degrees in course should be granted by the board of education through the University of the State of Pennsylvania, and to it should be affiliated all examining boards, such as those that now admit to the practise of law, of medicine, of pharmacy and of other professions requiring a state license.

In this way the state would unify and advance the work of higher education.

From the state board of education should come appointments for all scientific and technical commissions, thus enlisting for the state and its needs the service of trained experts in law and legislation, in medicine and the prevention of disease, in mining and other branches of scientific and technical subjects of inquiry.

Such commissions would go far to make a substantial return to the state for the income from a mill tax.

The preparation of a code of laws for the distribution of such an income could follow a provision in the proposed new constitution for the automatic collection of such a state mill tax for higher education.

A similar constitutional provision might be made for a tax for the support of purely public charities, under such regulations as would secure to the state and its people the highest efficiency and the most economical management of hospitals, homes, asylums for the insane, the blind and defectives and dependents.

The state board of charities should be given large powers of inspection and require standards of excellence that would put all such institutions in the highest state of efficiency.

Uniform methods of accounting, supervision of purchases of supplies, constant interchange of officers in charge would secure reforms that of themselves would invite increased gifts from individuals.

With a state mill tax for higher education and for purely public charities, Pennsylvania would take its place with the great western states, in which, with this fostering care, universities have rapidly grown great, in useful work and good results as well as numbers.

Reprisals, Contraband and Piracy under Queen Elizabeth: EDWARD P. CHEYNEY, A.M., LL.D.

The English had the reputation in the sixteenth

century of being the greatest pirates in Europe. Everywhere that English ambassadors went they were forced to hear complaints of the seizures at sea by their fellow countrymen. The Venetian governor of the Island of Zante reports to his home government, "I am firmly convinced that there is not a sailor of that nation that is not a pirate." The reasons for this bad reputation were fourfold. In the first place many letters of reprisal were given by the government. Admiralty courts in many countries were inefficient or not inclined to do justice, and English merchants, after failing to obtain justice for injuries suffered, appealed to their own government and were given letters of mark and reprisal authorizing them to reimburse themselves from the property of fellow countrymen of those who had injured them, even though the governments of the two countries were in close alliance. These letters of reprisal were objects of value and were sold, divided, bequeathed or seized for debt; whoever possessed one having a right to seize goods from foreigners up to the value expressed in it. Seizures made on the authority of such letters seemed legal enough to the possessors, but they were scarcely distinguishable from piracy in the eyes of those whose goods were seized. After 1585, when Spain seized the English ships that were then in her harbors, the English government gave these letters still more freely to any one who could bring forward any shadow of proof that he had lost goods in Spain. This practically amounted to privateering against that country.

Secondly, Spain was largely dependent for food and warlike supplies on France, Holland and the countries along the Baltic. When England and Spain went to war England declared all such supplies contraband and seized ships of those nations taking such goods to Spain. The law of contraband was not yet well developed and the merchants whose goods were seized naturally resented it and declared the actions of the English captains piracy.

Adventurers with letters of reprisal, privateers and captains in the Queen's service seizing contraband, all had commissions for what they did. But there were many genuine English pirates who had no commissions. Their names became famous, they were very bold, were often in collusion with fitting-out merchants on shore or with petty officials of the coast districts, and were comparatively seldom captured or punished. They attacked English and foreign vessels alike and threw overboard passengers and sailors and carried away ships and

goods. In 1573, when the Earl of Worcester was on his way to France to represent the Queen at the christening of the French King's daughter, some pirates swooped down on his ship and carried away all valuables, including the christening presents for the little princess.

The punishment of pirates was very difficult. The usual criminal courts would not act beyond the confines of their own countries and pirates' crimes were usually committed on the high seas. Therefore special courts had to be constructed for their trial. Nine hundred and sixty men were indicted in the special admiralty courts for piracy between 1568 and 1600. When convicted, pirates were usually executed on Wapping on the Thames, a mile or two below London. Twenty-eight were hung there in the year 1575 and fourteen in 1579. A narrative still remains of a pirate named Walton, being led from Southwark to Wapping to be hung, tearing strips from his breeches of crimson taffeta and handing them as keepsakes to his friends who followed him. The government also made strenuous efforts to put down piracy by the appointment of special commissions to hunt out pirates and their confederates and by sending fleets to sea to capture them.

There was, therefore, no lack of actual piracy, but probably not more on the part of the Englishmen than of men of other nationalities. The reason for the especial reputation of the English in this regard was that in addition to piracy of the usual kind they were held responsible for the seizures by letters of reprisal and by privateers and for carrying out the practise of capture of contraband goods, to which England was naturally led by the economic dependence of Spain and her own advantageous geographical location.

Some Commercial Transactions in Babylonia during the Period of Greek Supremacy: ALBERT T. CLAY, A.M., Ph.D.

The Historical Value of the Patriarchal Narratives: GEORGE A. BARTON, A.M., Ph.D.

The science of history has revolutionized our knowledge with reference to the early history of all peoples, showing that the traditions of nations usually begin with mythical stories, which give place gradually to legends, and later emerge into history that is attested by approximately contemporary documents. Inevitably in the progress of knowledge scientific methods have been applied to sacred history. To-day scholars are divided, so far as the patriarchal narratives are concerned, into three groups. (1) The sincere, open-minded, reverent scholars, who believe that the scientific

methods must be applied to the beginnings of the history of Israel as to those of other nations. (2) The reactionaries, who resent the application of scientific methods to ancient history. (3) The mythological, or pseudo-scientific school, which has become enamored of the scientific method from afar, but has never undergone real historical training. This school would regard most of the Biblical characters as mythical.

The tenth chapter of Genesis personifies Egypt, Elam, Assyria and many other nations as men. We know that these nations were not descended from one man. Whenever, then, we find a patriarch and a nation or tribe bearing the same name, it is scientific to assume that the patriarch is a personification of the nation or tribe. Arabian tribal traditions afford similar analogies. The twelve sons of Jacob are, then, the personification of the twelve tribes, and their history is tribal history. This was shown to apply to all but Joseph. There never was a tribe Joseph, but two tribes, Ephraim and Manasseh. The marriages of Jacob represent tribal alliances. Neither Joseph, Jacob nor Abraham can be accounted for in that way, as there were no tribes bearing these names. Are these three patriarchs, accordingly, nothing but myths? Is Abraham a moon-god as the pseudo-scientific school holds? Jacob-el, Joseph-el and Abraham were shown from Babylonian inscriptions to have been personal names in Babylonia before 2000 B.C., Jacob-el being sometimes even there shortened to Jacob. Records of Egyptian conquests of Palestine show that there were cities in Palestine named for a Jacob-el, a Joseph-el and an Abram. Many sources point to migrations from Babylonia to Palestine. Probably such men, heading migrations of Amorites, settled in Palestine and cities were named after them, just as we have our Jonesvilles, Billings, etc., in this country. When later Hebrews settled in these cities they gradually took over the names of the men from whom the cities were named, and wove them into their traditions. Around these names traditions gathered from many quarters were crystallized. These traditions can often be shown to embody real history, though history of a different sort from that supposed by the unscientific student of the Bible. Historical study thus makes it more probable that real men stand behind the stories of Joseph, Jacob and Abraham and that they are mythological personages. Many documents were quoted to substantiate the positions taken. One of the most interesting is a contract in which Abraham took part. It reads:

"1 ox, broken to the yoke,
 an ox of Ibni-Sin son of Sin-imgurâni,
 from Ibni-Sin
 through the agency of Kishti-Nabium,
 son of Eteru,
 Abarama (*i. e.*, Abraham) son of Awel-Ishtar
 has hired for 1 month.
 For 1 month
 1 shekel of silver
 he will pay.
 Of it $\frac{1}{2}$ shekel of silver
 from the hand of Abarama
 Kishti-Nabium has received."

The Succession of Human Types in the Glacial and Interglacial Epochs of the European Pleistocene: HENRY FAIRFIELD OSBORN, D.Sc., LL.D.

The Flora of Bermuda (illustrated): STEWARDSON BROWN. Introduced by Professor Henry Kraemer.

In the studies of the land flora of Bermuda which have been carried on since September, 1905, in cooperation with the New York Botanical Garden, the islands have been visited during parts at least of all the months of the year except January, July and October. More than 1,450 separate collections of plants have been made from all parts of the archipelago with the exception of a few of the smaller islands which are only rocks with but little vegetation. The native species of flowering plants and ferns exclusive of the endemic forms number 155, all of which are identical with those existing on the American mainland or the west Indian islands. The fourteen endemic species, four of which have been added through these studies, are all more or less nearly related to those of the southeastern United States, West Indies or tropical continental America and probably derived from such ancestors by modification during long periods of isolation. It would appear, therefore, that the greater portion of the native flora has come to Bermuda from the southwest through the agency of ocean currents, hurricane winds and migratory birds, of which a considerable number of species visit the islands regularly each year.

A New Type of Sewage Disposal Tank: WILLIAM PITT MASON, M.D., LL.D.

Determination of Uranium and Vanadium in Carnotite Ores of Colorado: ANDREW A. BLAIR.

FRIDAY, APRIL 18—MORNING SESSION

William W. Keen, M.D., LL.D., president,
 in the chair

The Uses and Needs of Selachology (The Study of Sharks and Rays): BURT G. WILDER, M.D.

Interpretations of Brain Weight (illustrated): HENRY H. DONALDSON, Ph.D., D.Sc.

The Correlation of Structural Development and Function in the Growth of the Vertebrate Nervous System (illustrated): GEORGE E. COGHILL, Ph.D. Introduced by Dr. H. H. Donaldson.

Recent studies in comparative neurology have resolved the central nervous system of vertebrates into four longitudinal divisions which are severally functional units. Among lower vertebrates the relative development of these divisions, the somatic sensory, the visceral sensory, the somatic motor and the visceral motor, has been in a significant manner correlated with the behavior of the species. Such correlations by the comparative method formed the point of departure for this study on the correlation of the behavior of embryos with the developing structures in the growth of the nervous system.

Embryos of Amphibia are found to be somatic sensory and somatic motor organisms. They give no evidence of visceral nervous functions until after the locomotor mechanism has become established. This mechanism develops out of three types of nerve cells, sensory, associative and motor. The sensory system of the trunk is formed of the giant ganglion cells of the spinal cord, which connect with the skin by means of dendritic processes. This sensory system of the trunk becomes functional earlier than does the sensory system of the head, which is the definitive system of cranial nerves. The associative cells form a ventral commissure between the sensory cells of one side and the motor cells of the other. The motor cells hold a relatively ventral position in the spinal cord and lower portion of the brain. They form a continuous motor column and tract on either side and connect with the muscles by means of collaterals from their axones. The development of this system of reflex arcs with a single final common path on either side may be distinctly correlated with the development of the behavior of the embryo up till the time when locomotion becomes perfectly established.

Some of the more general results of this method of study are: (1) the demonstration of the nature of the primary reflex arc of the vertebrate nervous system, (2) the discovery of the adaptive nature of the early reflexes when considered from the phylogenetic point of view, (3) proof that the final common path of the most primitive reflexes is elaborated into the nervous mechanism of locomotion, (4) the explanation of the typical be-

havior of a vertebrate upon the basis of demonstrable reflex arcs, (5) a distinctive contribution towards a biological neurology.

The Correlation of Structure and Function in the Development of the Nervous System (illustrated): STEWART PATON, M.D. Introduced by Dr. A. C. Abbott.

The Relation between the Physical State of the Brain Cells and Brain Function (experimental and clinical): GEORGE W. CRILE, M.D., Ph.D.

Life of Cells Outside the Organism (illustrated): ROSS G. HARRISON, M.D., Ph.D. Introduced by Dr. A. C. Abbott.

Heredity and Selection: WILLIAM E. CASTLE, Ph.D.

The Nature of Sex and the Method of its Determination (illustrated): CLARENCE E. MCCLUNG, A.M., Ph.D. Introduced by Dr. George A. Pier-sol.

Fever: Its Nature and Significance: VICTOR C. VAUGHAN, M.D., LL.D.

It has been shown experimentally that fever is due to the digestion of proteins in the blood and in the tissues. Bacteria are living proteins. They get into the body and grow, converting the proteins of man's body into bacterial proteins. After a period of incubation the cells of the body pour out a ferment which digests and destroys the bacteria. In this process fever originates. In itself fever is beneficial. It is a manifestation of the attempt on the part of nature to destroy the invading organism. However, nature may overdo the matter, and fever per se becomes dangerous when it goes much above 105°. Any kind of fever, acute fatal, intermittent, remittent or continued, may be induced in animals by repeated injections of properly graduated doses of foreign protein.

The Control of Typhoid Fever by Vaccination: MAZYCK P. RAVENEL, M.D.

Vaccination against typhoid fever as practised to-day we owe to the researches of Dr. (now Sir) Almroth E. Wright.

It was tried for the first time on a large scale during the Boer war. Since that time it has undergone investigation by scientific boards in several countries. In the United States it was recommended by such a board in 1909. The results were so favorable that it was made compulsory for all officers and enlisted men under forty-five years of age in 1911.

The most striking results were obtained during the mobilization of troops in Texas in 1911. There were 12,801 troops in Texas, all vaccinated.

There was only one case of typhoid fever, occurring in a private of the hospital corps, who had not completed his immunization. The case was mild, and resulted in recovery. In 1898, 10,759 troops were stationed in Jacksonville, Florida, under very much the same conditions as regards climate, etc. Vaccination was not practised at that time. There were 2,693 cases known or believed to be typhoid fever, with 248 deaths. Wherever practised, very much the same story is told. The French troops in Morocco under most unhygienic surroundings have entirely escaped typhoid fever where vaccination was practised.

The method is an extension of the well-known bacterial vaccination discovered by Pasteur. It is now generally recommended for nurses in hospitals and those exposed to the disease.

In Wisconsin the State Laboratory of Hygiene sends out the vaccine free of charge to all physicians in the state. In more than three thousand vaccinations only two cases of typhoid fever have come to our notice; both of these cases mild and atypical.

The method has shown itself of great value in checking epidemics, and in the cure of typhoid carriers.

FRIDAY, APRIL 18—AFTERNOON SESSION

William B. Scott, Ph.D., LL.D., vice-president,
in the chair

Guatemala and the Highest Native American Civilization: ELLSWORTH HUNTINGTON, M.A., Ph.D. Introduced by Mr. Henry G. Bryant.

Among the native civilizations of the western hemisphere that of the Mayas was decidedly the highest. Not only did they develop the arts of architecture and sculpture to a surprisingly high point, considering the fact that they had no tools of iron, but they were the only American race to evolve the art of genuine hieroglyphic writing. To-day the magnificent ruins of the later, decadent Maya period, dating about A.D. 1000, are relatively accessible, as they lie in the comparatively dry, open and well-populated strip which borders the peninsula of Yucatan on the north. The oldest ruins, however, those representing the period of highest development a few centuries after the time of Christ, are located in one of the most inaccessible, least explored, most unhealthful and most sparsely populated regions of America. The Guatemalan province of Peten, together with the immediately surrounding regions, where the greatest ruins are located, consists of a plain or low hills lying between the Atlantic Ocean on the east,

the Gulf of Mexico on the north and the high volcanic plateau of Guatemala on the west and south. It is to-day one of the worst possible environments for man. In the first place, it receives so much rain that it is covered for the most part with a dense tropical forest or jungle where the excessive moisture and rank growth of vegetation render it practically impossible to make clearings and practise anything but the most haphazard agriculture. In the second place the region suffers to a maximum degree from the disadvantages of a uniformly warm, moist, debilitating climate. And finally it is afflicted with the worst kind of tropical fevers which weaken and destroy white men and natives alike and render thousands of square miles practically uninhabited.

To-day Peten stands at the lowest point in the scale of American civilization. Close beside it the Guatemalan plateau with its drier, less debilitating climate, less dense vegetation, and relative absence of malarial fevers, is far in advance of it, although inhabited by practically the same race and governed by the same laws. Formerly the reverse was true; the plateau was, relatively speaking, only moderately advanced; that is, it was a provincial region, while the lowland was for many centuries the seat of a culture equal to that of the highest races of the eastern hemisphere before the days of Greece. In the last 1,500 years, more or less, there has evidently taken place a change of great magnitude. In explanation of this change three possibilities present themselves. First, the Mayas may have possessed a degree of energy and initiative and of resistance to fevers and to the debilitating influence of the torrid zone much in excess of that of any other known people. Second, in their day tropical fevers of the more destructive types may have been unknown in Central America; and, third, the climate may have changed. All three theories are probably true in part, but there is no independent evidence as to the first two. On the other hand, alluvial terraces and their relation to such ruins as Copan furnish strong independent evidence of climatic pulsations during the past 2,000 years. We are therefore led to conclude that although the Mayas were a remarkable people they did not of necessity excel all other races in their resistance to disease and in their power of overcoming the obstacles of a habitat—lowland forests in the moister portions of the torrid zone. In their day, apparently, the earth's climatic zones were shifted somewhat equatorward, so that in winter the conditions of the dry subtropical zone of high pressure and perhaps the

rainless fringes of our cyclonic storms prevailed in the country. The yearly dry season thus produced, probably prevented the growth of dense forests, made agriculture possible, greatly reduced the amount of disease and acted as a direct stimulant by relieving the deadening monotony of the almost unchanging moist heat. A relatively slight climatic change such as this would alter the physical environment of Peten from exceedingly unfavorable to relatively favorable, and would render the location of the highest native American civilization rational instead of almost inexplicable.

Further Considerations on the Origin of the Himalaya Mountains and the Plateau of Tibet: T. J. J. SEE, A.M., Ph.D.

Dana's Contribution to Darwin's Theory of Coral Reefs: WILLIAM MORRIS DAVIS, Sc.D., Ph.D.

It is fitting on the hundredth anniversary of Dana's birth to call attention to a significant contribution that he made many years ago to Darwin's theory of coral reefs, all the more because, although it has high confirmatory value, it has been strangely overlooked by most students of the coral island problem. Darwin, as is well known, explained barrier reefs by an upgrowth of the corals of fringing reefs during a slow subsidence of the central island on which they were established; but he did not offer any direct confirmatory evidence of the truth of his fundamental assumption of subsidence. Dana furnished independent confirmatory evidence of the assumption by pointing out that the central islands of barrier reefs are, as far as he had descriptions of them, characterized by embayed coast lines, precisely such as must result if they had subsided; all of their valleys are invaded by the sea and converted into bays. Darwin had noted this fact, but had not perceived its significance, probably because he did not understand that the embayments of a coast line are in nearly all cases formed by the submergence or drowning of preexistent valleys. Dana was the first observer in the world to bring forward this explanation, to-day everywhere accepted, and the first also to apply it to the central islands of barrier reefs. In recent years several Australasian observers have resurrected Dana's idea, and have found in it, as he did, a strong confirmation of Darwin's original theory.

The Formation of Coal Beds: JOHN J. STEVENSON, A.M., LL.D.

Cambrian Fossils from British Columbia (illustrated): CHARLES D. WALCOTT, Ph.D., Sc.D., LL.D.

Dr. Walcott gave illustrations of a very remark-

able and ancient fossil fauna discovered by him in the mountains of British Columbia, 2,000 feet above Field, on the Canadian Pacific Railway.

The fossils are most beautifully preserved and include such delicate forms as medusæ (jelly fishes), holothurians (sea cucumbers), finely preserved marine shells of various kinds and a large variety of crustaceans. Some of the latter are so perfectly preserved that the branchia, legs and alimentary canal are shown, and even in several forms the liver is so perfect that the ramifications of the tubes through it are reproduced by photography and thus illustrated by lantern slides.

Altogether over 80 genera of invertebrate fossils have been found from a bed not over 5 feet in thickness. They are all of marine origin and lived at a period when there were no vertebrates (fishes, reptiles, mammals) in existence.

The Alleghenian Divide and its Influence upon Fresh-water Faunas: ARNOLD E. ORTMANN, Ph.D., ScD.

Although it is well known that the Allegheny Mountains form a general boundary between the aquatic forms inhabiting their western and eastern slopes, particulars about the relations of the two faunas were missing. In fact, the fundamental facts, the actual faunas of the various streams, chiefly in the mountains, were unknown.

The writer furnishes first these facts for a number of aquatic forms of life, chiefly the fresh-water mussels, the Pleuroceridæ and the crayfishes, covering the region from the New York-Pennsylvania state line to the northern boundary of Tennessee. The main results are, that the groups mentioned have not been transported over land to any extent, and consequently are apt to furnish evidence as to the former drainage conditions. The Allegheny Mountains have acted most of the time as an effective barrier to the dispersal of fresh-water life, surely so since the end of the Cretaceous. The Atlantic side received its fauna from the Interior Basin, but not across the mountains, but around their northern and southern ends. A few instances are known, where single species have crossed the divide, and these cases are found in two sharply-restricted regions: they are probably due to stream piracy.

Neutralization and Elimination of Toxic Substances: OSWALD SCHREINER, Ph.D.

*Progressive Evolution among Hybrids of *Oenothera** (illustrated): BRADLEY M. DAVIS, A.M., Ph.D. Introduced by Professor John M. Macfarlane. Certain cultures of hybrids between *Oenothera*

biennis and *Oenothera grandiflora* have presented in the second generation a high degree of progressive advance in flower size and in the size of the leaves and the extent of their crinkling. A hypothesis for such progressive evolution is offered by the Mendelian principle of recombination of factors for large size on the assumption of multiple factors for the dimensions of organs, but this hypothesis also demands the presence in the same culture of groups of plants containing the factors for small size. When in an F_2 generation there is a considerable group of plants with flowers larger than those of the larger parent there should also be expected corresponding groups with flowers as small or smaller than those of the smaller parent. This follows on the Mendelian law of the conservation of factors by which the factors contained in an F_1 hybrid must all come out in an F_2 generation, provided that this generation is sufficiently numerous and that the formation and mating of gametes present no exceptional features. In F_2 generations of about 1,000 and 1,500 plants, respectively, there were no groups of plants with flowers as small as or smaller than those of *biennis*, the small-flowered parent. There were thus no groups to balance the large proportion of plants with flowers larger than those of the *grandiflora* parent. The cultures as a whole presented a marked advance in flower size.

A similar situation was presented by the character of the foliage in certain F_2 generations. The leaves throughout the mass of these cultures were much larger than those of the parents and generally much more crinkled. There was thus a marked progressive advance in leaf size with the absence of small-leaved groups of plants, and it is difficult to explain the results on strict Mendelian principles of segregation according to which groups in an F_2 generation containing the factors for large leaf-size should be accompanied by corresponding groups containing the factors for small leaf-size.

There was in these F_2 generations abundant evidence of segregation as shown in a range of variation far above that presented by F_1 generations, but this range was between groups of plants with flower and leaf size much greater than those of the two parents. Thus the petals in the larger-flowered groups were 1 cm. longer than those of the *grandiflora* parent with petals 3.3 cm. long, and the flowers of the smaller groups were two or more times larger than those of the *biennis* parent with petals 1.3 cm. long.

Certain of the F_2 generations presented classes

of dwarfs in proportions as high as 1:9 and 1:5.7. These classes were sharply separated from the mass of the cultures and there were no intermediates between the two groups. The high proportions suggest the 1:5 ratio which might be expected if two factors for size were present, each allelomorphic to its absence. Such a simple explanation, however, calls for the appearance of corresponding classes of giants to balance the dwarfs and for several other classes of plants of different sizes composing the mass of the cultures; such classes were not found. The dwarfs then present a puzzling phenomenon not readily understood on current Mendelian views of the segregation of factors governing size.

Admitting the complexity of the situation when such an extreme cross is made as that between *Oenothera biennis* and *Oenothera grandiflora*, there still appears to the writer sufficient reason in the data at hand to present the problems as material for reflection on the Mendelian theory of the stability of factors and the principles of their distribution unchanged in the organization of gametes. The question naturally arises whether the phenomenon of the progressive advance exhibited in the F_2 generation of these hybrids as well as the formation of groups of dwarfs may not involve, as a result of the cross, the direct modification of factors for size.

Climatic Areas of the United States as Related to Plant Growth (illustrated): BURTON E. LIVINGSTON, Ph.D. Introduced by Professor John W. Harshberger.

This paper deals with that phase of plant geography which relates the distribution of the various forms of vegetation to climatic factors, a phase which is as important to scientific agriculture as it is to what is commonly termed pure science.

Following an introductory consideration of the nature of the problem to be dealt with and some remarks on the sort of means by which we may hope to obtain quantitative information upon the relation of plant growth to climatic conditions, attention is given to the subdivision of the United States into climatic areas more or less susceptible of quantitative definition. Climatic conditions, as far as they influence plants, must be considered mainly as two comparatively distinct groups of environmental factors. The first of these groups constitutes the moisture conditions, tending to furnish the plant with water or to withdraw moisture from its tissues. The second group, the temperature conditions, tend to increase or decrease the temperature of the plant body. As a primary

duration factor for the attempted integration or averaging of these climatic conditions, the length of the frostless season is introduced; for practically all animals and perhaps for most other plant forms in the United States, the conditions which are effective during the frostless season have far more influence on plant distribution than have those which are effective during the remainder of the year. Other time periods require attention, however.

From a somewhat thorough study of the climatic data which are at hand it appears that any two systems of isoclimatic lines, one system representing the geographical distribution of temperature conditions and the other representing that of moisture conditions, have a strong tendency to cross each other, thus dividing the country into many climatic areas, each one capable of quantitative description. The remainder of the paper concerns itself with a discussion of selected examples of these areas and of the natural vegetation which characterizes them. This line of study is in its reconnaissance stage and the results are quite tentative in their character.

The Day of the Last Judgment: PAUL HAUPT, Ph.D., LL.D.

The conception of the day of the last judgment is based on the idea of the day of the Lord in the Old Testament prophecies. Originally the judgment-day, resurrection and immortality referred to the Chosen People. The dry bones in Ezekiel xxxvii represent the Jewish nation in the Babylonian captivity. The so-called eschatological passages as well as the alleged Messianic prophecies have, as a rule, a definite historical background, but when the bills drawn on the future were not honored they were extended to doomsday.

The final chapter of the book of Joel does not contain an eschatological prophecy referring to the end of the world, but the confident prediction of an enthusiastic patriot expressing the hopes of the Maccabees for the near future. Nor does the last chapter of the book of Zachariah refer to the last judgment; originally it predicted merely a decisive victory of the Maccabees over their enemies about 140 B.C. and subsequent engineering improvements in and near Jerusalem.

The ideas of doomsday, resurrection and immortality are secondary, but Ernest Renan is right in saying that there is no lever capable of raising an entire people if once they have lost their faith in the immortality of the soul, and Dr. A. E. Garvey remarks: "He who lives for the ideals of truth,

beauty, goodness, lives not for time but for eternity."

On the Character and Adventures of Muladora:
MAURICE BLOOMFIELD, Ph.D., LL.D.

On Friday evening at the Hall of the Historical Society of Pennsylvania George Grant MacCurdy, A.M., Ph.D., assistant professor of archeology, Yale University, gave an illustrated lecture on "The Antiquity of Man in the Light of Recent Discoveries."

On Saturday morning at 9:30 o'clock an executive session was held in the hall of the society at which candidates for membership were balloted for. As a result of the election, the following new members were announced: *Residents of the United States*—George Francis Atkinson, Ph.D., Ithaca, N. Y.; Charles Edwin Bennett, A.B., Litt.D., Ithaca, N. Y.; John Henry Comstock, B.S., Ithaca, N. Y.; Reginald Aldworth Daly, Boston, Mass.; Luther Pfahler Eisenhart, Princeton, N. J.; George W. Goethals, Culebra, Canal Zone; William C. Gorgas, M.D., Sc.D., LL.D., Ancon, Canal Zone; Ross G. Harrison, A.B., Ph.D., M.D., New Haven, Conn.; George Augustus Hulett, Princeton, N. J.; Clarence E. McClung, A.M., Ph.D., Swarthmore, Pa.; John Dyneley Prince, Ph.D., Sterlington, N. Y.; Samuel Rea, Sc.D., Bryn Mawr, Pa.; Henry Norris Russell, Ph.D., Princeton, N. J.; Charles Schuchert, New Haven, Conn.; Witmer Stone, A.M., Philadelphia. *Foreign Residents*—Sir Arthur John Evans, D.Litt., LL.D., F.R.S., Oxford, England; Sir Joseph Larmor, D.Sc., LL.D., F.R.S., Cambridge, England; Arthur Schuster, Sc.D., Ph.D., F.R.S., Manchester, England.

SATURDAY, APRIL 19—MORNING SESSION

Edward C. Pickering, D.Sc., LL.D., F.R.S.,
vice-president, in the chair

The Potassium, Phosphorus, Nitrogen Cycles:
CHARLES E. MUNROE, Ph.D., LL.D., F.C.S.

An Ammonia System of Acids, Bases and Salts:
EDWARD C. FRANKLIN, M.S., Ph.D.

Some Unsolved Problems in Radioactivity (illustrated): WILLIAM DUANE, Ph.D. Introduced by Professor Arthur W. Goodspeed.

More than thirty different substances are known to be radioactive in much the same way that radium is radioactive. Most of these substances disappear more rapidly than radium does, only five of them having an average life greater than that of radium, which is about 2,000 years. The average lives of the others vary from a fraction of a second to 24 years.

The law according to which these substances disappear is the same for all of them. It may be stated thus: The rate at which any substance disappears is proportional to the quantity of that substance present, and absolutely independent of all conditions of temperature, pressure and state of chemical combination, etc. This is a very simple law, and the mathematical equations that can be deduced from it probably represent the facts as accurately as any known equations represent facts in other branches of science.

Looked at from another point of view, this law is not very easy to understand. Let us take a particular example. Suppose we have a quantity of that substance called radium emanation. The law applied to this quantity of radium emanation means: that certain atoms of emanation will explode and transform themselves into radium *A*, during the next few seconds, whereas other atoms of this same emanation will remain emanation atoms for a long time, and will not transform themselves for months to come. The question is this: How can atoms which are physically and chemically similar to each other, yet be so different that some of them will disappear immediately and others not for a long time. The explanation of this probably lies in the internal structure of the atom and not in external causes, for external conditions have no known effect upon the phenomenon.

The second unsolved problem to which I wish to call your attention is connected with the rays given off by the substances during their transformations. Some substances produce what are called α -rays and some β -rays, and other substances produce both α - and β -rays. If a particular substance produces α -rays, one and only one α -particle is ejected during the transformation of each atom of that substance, and the same is true of the β -rays. The α -particles from the same substance all have the same velocity. For instance, the α -rays from radium *C* all have a velocity of 2.09×10^{10} . The β -rays, however, from the same substance do not all have the same velocity. Each β -particle has one of a certain number (8 or 10) of well-defined velocities. For example, each β -particle projected from an atom of radium *C* must choose one of a certain set of velocities lying between 1.85×10^{10} and 2.99×10^{10} cm./sec.

It is difficult to understand why the explosion of an atom, say of radium *C*, which, so far as known, is just like the explosion of every other atom of radium *C*, and produces an α -ray of a

certain definite velocity, should produce a β -ray, having now one velocity and now another. Several attempts to explain this phenomenon have been made, but without complete success. Doubtless the true explanation must be sought for in the internal structure of atoms, as in the first problem mentioned above.

The third problem I will mention has to do with the γ -rays. It is known that the γ -rays are intimately connected with the β -rays, each type of ray being capable of producing the other, but the exact relationship between them is not very well understood. The particular question, however, that I wish to bring up is this: is the γ -ray a wave form spreading out as sound waves do from their source, or is it of corpuscular nature resembling the sparks projected from an exploding rocket? The fact that the velocity of the β -ray, which the γ -ray is capable of producing, does not depend upon the distance from the source of the γ -ray to the point at which the β -ray is produced seems to indicate that the latter hypothesis is correct.

The explanations of these phenomena are intimately connected with the theories of interaction of matter and electricity, and it is interesting to note that the theory, which in modern times has been of most use, the theory according to which both matter and electricity are of atomic nature, was first promulgated about 150 years ago in our own city of Philadelphia by no other than Benjamin Franklin himself, the founder of this society.

Perhaps the most important radioactive problem of practical value upon which scientists are working to-day is the effect produced by the various radiations on human tumors. Photographs were shown illustrating the results obtained in France and Germany by subjecting small superficial cancers to the action of the rays. It must be remembered that the problem of curing deep-seated malignant tumors is by no means solved.

Some Diffraction Phenomena; Superposed Fringes:
CHARLES F. BRUSH, Ph.D., LL.D.

Diffraction fringes, as usually seen, are not affected by thickness or contour of a smooth, straight diffracting edge, as pointed out by Fresnel. The author finds, however, that when the fringes outside the shadow are observed within one or two millimeters from the diffracting edge, by means of a microscope, their brightness and sharpness are very greatly affected by the character of the edge. For instance, a cylindrical edge of several millimeters radius gives vastly brighter fringes than a sharp razor edge. He finds this is due to super-

position of many diffraction fringe patterns which are nearly in register. They are believed to be formed by many contiguous elements of the cylindrical surface, each acting as a diffracting edge and producing its own fringes. The author further shows that the so-called "single mirror interference fringes" of Lloyd may be produced under conditions which preclude reflection, and which at the same time make it obvious that they are formed by superposition of diffraction fringes.

Matter in its Electrically Explosive State: FRANCIS E. NIPHER, A.M., LL.D.

New Investigations on Resonance Spectra: R. W. WOOD, Ph.D.

Application of Recent Studies on the Origin of the Earth's Magnetic Field to the Possible Magnetic Fields of Rotating Bodies in General (illustrated): LOUIS A. BAUER, Ph.D.

The Determination of Visual Stellar Magnitudes by Photography: EDWARD C. PICKERING, D.Sc., LL.D., F.R.S.

Ordinary photographic plates are most sensitive to blue light, while the yellow rays are those that affect the eye most strongly. Accordingly, blue stars appear brighter and red stars fainter in a photograph than to the eye. Isochromatic plates are, however, manufactured which are very sensitive to yellow light. If a yellow screen is interposed the blue light is cut off and red stars appear even brighter, relatively, than they do to the eye. By using a thin yellow screen which cuts off only a portion of the blue rays it is possible to obtain plates having the same color index as the eye. To fulfil this condition several blue and several red stars have been selected near the North Pole. Photographs are then taken with different screens until one is found which gives images of the same relative brightness as the naked eye. With the 16-inch Metcalf Telescope at Harvard, stars as faint as the twelfth magnitude may be photographed in this way with an exposure of ten minutes. With an exposure of two hours, stars can be photographed about as faint as they can be seen with a telescope of the same size. On a perfectly clear night a photograph is taken of the North Pole with exactly 10 minutes' exposure, then similar exposures on four different regions, then a second time on the North Pole, on five other regions, and a third time on the North Pole. The twelve plates are developed together and various precautions taken to secure uniform results. The magnitudes of numerous stars near the North Pole have been measured with great care and the mag-

nitudes of stars on the other plates can thus be determined on the same scale.

Some Problems in Connection with the Milky Way as shown by Photographs with a Portrait Lens: EDWARD E. BARNARD, Sc.D., LL.D.

The Spectroscopic Detection of the Rotation Period of Uranus: PERCIVAL LOWELL, LL.D., and V. M. SLIPHER, Ph.D.

By means of the spectroscope, it is possible to measure the speed of approach or recession of a luminous body; for the lines of the spectrum are shifted toward the violet or red in proportion as the body moves toward or from the observer. Hence, if the image of a rotating planet be so thrown upon the slit of the spectroscope that one end of the slit is illuminated by light from the approaching side of the planet and the other end by light from the receding side, the lines will be tilted through an angle which measures the speed of rotation.

In this way, from spectrograms obtained at the Lowell Observatory in 1911, the authors determined the rotation of the planet Uranus about its axis to take place in ten hours and fifty minutes, in a direction opposite to that of the rotation of the planets nearer the sun. Thus, for the first time, an authentic determination of the rotation of this planet has been made by a direct method.

On the Spectrum of the Nebula in the Pleiades: V. M. SLIPHER, Ph.D.

Two photographs of the spectrum of the faint nebula near Merope, a bright star in the Pleiades, were obtained in December, 1912, with a slit spectrograph attached to the Lowell 24-inch refractor. The two plates were exposed five and twenty-one hours, respectively. They agree in showing a continuous spectrum crossed by the dark lines of hydrogen and helium, the spectrum of the nebula being a true copy of that of the brighter stars of the Pleiades. The light of the nebula is thus shown to be of stellar origin. As it seems improbable that a mass of stars, all of the same spectral type as the Pleiades, should so group themselves behind the Pleiades as to give the appearance of a nebula, the author believes it more probable that the nebula consists of diffused material surrounding the stars and shining by reflected star light.

This is the first successful observation ever published upon the spectrum of this faint nebula.

Eclipsing Variable Stars: HENRY NORRIS RUSSELL, Ph.D. Introduced by Professor William F. Magie.

Progress of New Lunar Tables: ERNEST W. BROWN, M.A., Sc.D., F.R.S.

SATURDAY, APRIL 19—AFTERNOON SESSION

Edward C. Pickering, D.Sc., LL.D., F.R.S., vice-president, in the chair

Presentation of a portrait of William W. Keen, M.D., LL.D., president of the society, by Joseph G. Rosengarten, A.M., LL.D., on behalf of the subscribers.

Vice-president Pickering accepted Dr. Keen's portrait on behalf of the society.

The rest of the session was occupied by a symposium on Wireless Telegraphy and Telephony, during which the following papers were read:

Radiated and Received Energy: LEWIS W. AUSTIN, Ph.D. Introduced by Professor William F. Magie.

Mathematical theory indicates that the energy radiated from a radiotelegraphic antenna proportional to the current in the sending antenna, to the height of the sending antenna, to the height of the receiving antenna, inversely proportional to the wave-length and inversely proportional to the distance between the two antennas. Since the loudness of signal is proportional to the square of the current in the receiving antenna, the signal falls off as the square of the distance between the two.

This law has been verified by the experiments made by the United States Navy Department between the new high-power station at Arlington and several other stations situated in and near Washington.

Observations at distances over 100 miles show that in addition to the diminution in intensity of signal with the distance, there is an absorption either in the atmosphere or ground such that at a distance of 1,000 miles over salt water with a wave-length of 1,000 meters the received current is only approximately 1/25; that is, the received signals are reduced to about 1/600 of what they would have been had there been no absorption.

The absorption decreases as the wave-length is increased, so that for communication over great distances, long waves, 4,000 to 7,000 meters in length, are used, while for short distances of a few hundred miles short waves are better since they are radiated more energetically. These facts apply to daylight communication only, which is in general regular, night ranges, though greater than day, being freakish and uncertain. The absorption over land is much greater than over water, especially for the shorter wave-lengths.

In recent tests between the Arlington station and the scout cruiser *Salem* on its voyage to Gibraltar and return, messages were received from Arlington in the day time on the *Salem* up to a distance of 2,100 nautical miles, and at night as far as Gibraltar.

A comparison was also made of the action of two types of sending sets, one being the regular spark sending set and the other set in which the waves are produced from an electric arc. It has been claimed that the continuous waves emitted by the arc are less absorbed than the broken-up trains of waves produced by the spark. Up to 1,000 miles no difference in the absorption was observed, but at 2,000 miles the observations indicated that the received arc energy was relatively four times greater than that of the spark.

Resonance in Radiotelegraphic Receiving Stations:

GEORGE W. PIERCE, A.M., Ph.D. Introduced by Professor Arthur W. Goodspeed.

A New Form of Resonance Circuits: MICHAEL I. PUPIN, Ph.D., Sc.D.

The International Radiotelegraphic Conference of London and its Work: ARTHUR GORDON WEBSTER, Ph.D., LL.D.

The great development of wireless telegraphy and the embarrassment arising from interference in communication and the refusal of different companies to transmit messages at sea led to the necessity of international control, and brought about the Conference of Berlin in 1906. It was then decided that these conferences should be periodic, and the second one was held in London in June and July, 1912. The United States sent a delegation of twelve members, representing various departments, including the army, navy and commerce and labor. The working of the conference was described, and the strong personnel of the representatives of the more than forty countries represented. All governments except that of the United States, owning the telegraphs, are able to exercise absolute control, and were represented by high officials of their post-office and telegraph administrations, as well as by military officers.

The work of the conference was concerned mainly with the questions of prevention of interference between different stations, of increasing the safety of vessels and of the prevention of abuses in improper competition, the latter being a matter in which this country was not interested. The question of interference occupied the major

part of the time of the conference. Two standard wave-lengths were adopted, which were made obligatory, so that there could be no excuse for not hearing messages. The amount of power to be used was limited, so that it should not be in the power of one station to drown out others. On account of difficulties in crowded waters like the English channel, surrounded by several nations, strict rules of precedence were established and the multiplication of useless calls was restricted. Attempts to overreach one country by powerful stations belonging to another caused considerable feeling and were regulated.

In the interest of security, all stations are to be licensed by their governments. Operators must also be licensed, and shall be of two classes, according to proficiency. Operators of the second class are to be permitted only on small ships, and as substitutes on those having one operator of the first class. The wireless stations are put under the authority of the officer in command of the ship. On passenger ships there must be a special emergency plant capable of operation independently of the ship's power, and strong enough to reach eighty miles. Such stations must listen for distress calls for ten minutes of each hour. High-power shore stations must periodically cease transmitting, in order not to interfere with distress calls. Distress calls are given absolute preference. The transmission of meteorological news is facilitated by giving it priority, when sent to certain designated designations.

The author expressed the opinion that in spite of all that had been done, before the next conference, to be held in Washington in 1917, wireless traffic would have so increased that much more stringent regulations, as well as improved methods of tuning, would be necessary.

A general discussion followed, led by Professor Elihu Thomson.

At the annual dinner on Saturday evening, at the Bellevue-Stratford, over one hundred members and guests were present, the toasts being responded to as follows:

"The Memory of Franklin," by His Excellency the French Ambassador.

"Our Guests," by Professor Arthur Schuster.

"Our Institutions of Learning," by Professor A. G. Webster.

"The American Philosophical Society," by Mr. Hampton L. Carson.

ARTHUR WILLIS GOODSPEED

PHILADELPHIA,
April 23, 1913